TEST PROCEDURE

TP 708F	
Title Exhaust Sample Analysis	**Page Number** 1 of 31
Originator Daniel McBryde, Mechanical Engineering Technician	**Supersedes** TP 708D
Responsible Organization Vehicle Testing (VT)	**Computer Program** 1200 System
Type of Test Report Form and Computer	**Data Form Number** Form 708-01
Report Distribution Divisions of the National Vehicle and Fuel Emissions Laboratory, Manufacturer Operation Division, and Vehicle Manufacturers	**Implementation Date** 06-23-95

Implementation Approval

Original Test Procedure Authorized on 09-30-94 by EPCN #083

Revision Description

(1) 06-23-95 The purpose of this change is to revise the procedure as described in EPCN #187. All steps affected by this change are identified with (1) in the margin.

Note: Specific brand names in EPA/EOD procedures are for reference only and are not an endorsement of those products.

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Attachments

1. Purpose

The purpose of this procedure is to analyze constituents of the diluted exhaust gas emission samples collected by a Constant Volume Sampler (CVS) from light-duty petroleum-fueled vehicles during a chassis dynamometer test.

Constituents analyzed include:

hydrocarbons (HC)

oxides of nitrogen (NO_x)

carbon dioxide (CO_2)

carbon monoxide (CO)

and if required, methane (CH_4)

This analysis procedure is designed to be performed concurrently with several exhaust sample collection procedures including, but not limited to the following:

TP 707, Sample Collection of the Urban Dynamometer Exhaust Emission Test

TP 710, Sample Collection of the Highway Fuel Economy Test

Other exhaust sample collection procedures

2. Test Article Description

Light-duty vehicles scheduled for Certification, Fuel Economy, Enforcement, or other testing

3. References

3.1 "Code of Federal Regulations," Title 40, Subpart B Sections 86.106, 86.109, 86.111, 86.114, 86.116, 86.121, 86.122, 86.123, 86.124, 86.125, 86.126, 86.127, 86.130, 86.135, 86.136, 86.137, 86.140, 86.142, and 86.144

3.2 "Environmental Protection Agency (EPA) Engineering Operation Division (EOD) Test Procedures Manual." References to the EOD Test Procedures include subsequent revisions.

3.3 Eric Zellin's Technical Report, "Software Zero and Span for a Laboratory Computer System," dated March 1982. (Attachment A)

3.4 Environmental Protection Agency current safety policies

4. Required Equipment

4.1 Form 708-01, “Vehicle Test Data Sheet,” (Attachment B)
Form 801-01, “Data Location”
Form 902-01, “Test Status Report”
“VDA Summary Report”

4.2 Exhaust Gas Sampling System:

4.2.1 Critical Flow Venturi - Constant Volume Sampler (CFV-CVS)

Equipment used: Philco Ford Model CVS-20 (D001-D005)
Horiba Instruments, Inc., Model 1050
CVS Heat/Cool/Filter (D006)

4.2.2 CVS Compressor Unit (Blower)

Equipment used: Spencer Turbine Co. Model 2007-H Turbo-Compressor (D001 - D005)
Horiba Instruments, Inc., Model 1050 Compressor (D006)

4.3 Exhaust Gas Analytical System

4.3.1 Analyzer control module containing Analyzer Mode Selector (AMS), CVS Sample Control, and TAP Control Panel

Equipment used: Custom fabricated to meet VT requirements

4.3.2 HC measurement - Flame Ionization Detector (FID)

Equipment used: Beckman Model 400, modified for range alignment

4.3.3 NO_x measurement - Chemiluminescence analyzer

Equipment used: Beckman Model 951A

4.3.4 CO_2 measurement - Non-dispersive Infrared (NDIR) analyzer

Equipment used: Horiba Model AIA-23

4.3.5 Low CO (LCO) measurement - NDIR for concentrations of 500 ppm or less

Equipment used: Horiba Model AIA-23 <A.S.>

4.3.6 High CO (HCO) measurement - NDIR for concentrations of 500 ppm or greater

Equipment used: Horiba Model AIA-23

4.3.7 CH_4 measurement - Gas Chromatograph analyzer

Equipment used: Bendix Model 8205

4.3.8 Strip chart recorder, six channels. The HC, NO_x, LCO, HCO, CO_2, and CH_4 analyzers are connected to one channel each.

Equipment used: Soltec Model 3316

4.3.9 Digital Voltmeter (DVM), with switchable connections to each of the analyzers

Equipment used: Weston DVM

4.4 Test Analysis Processor (TAP) Flag Directory, (Attachment D). References to the TAP Flag Directory include subsequent revisions.

4.5 Laboratory Computer System (LCS) and Test Analysis Processor (TAP)

Equipment used: Gould 32/75 Real-Time Computer with Computer Products Real-Time Peripheral (RTP) instrument interface

Datasouth Computer Corporation Model DS120 (a converted Digital Equipment Corp. terminal)

Decwriter II terminal Model #LA36DK, with pressure-sensitive 3-part paper and ribbons stored in its vicinity, and the analyzer/ LCS interface panel located on the analyzer control module

5. Precautions

5.1 The Instrument Exhaust Gas Alarm is located in the Analyzer Control Module (ACM). The green "ON" light of the ON/Fault button should be illuminated if it is working properly; if it is not illuminated, press the ON/Fault button to reset.

If the green "ON" light does not illuminate, notify the Calibration and Maintenance (C&M) Manager.

If the red "Fault" light is illuminated, vacate the area and notify the C&M Manager and VT supervisory personnel.

5.2 Safety precautions must be followed when using compressed gases. Carbon monoxide, Nitric Oxide (NO), and Ozone (O_3) are toxic.

6. Visual Inspection

6.1 Ensure that the power is on for all analyzers, the strip chart recorder, and related equipment.

When the strip chart recorder power has been off for any period of time, an equal period of time with the recorder power on is required for instrument warmup; e.g., a 1-minute power off requires a 1-minute warmup, etc., up to a 1-hour maximum required warmup.

If you are unable to determine how long the recorder has been off, you must allow the recorder to warm up for a minimum of 1 hour.

If you turn on a recorder, write "power on at" and the time the recorder was turned on.

6.2 Ensure that the HC-FID and CH_4 analyzers are lit and that the NO_X analyzer is in the "NO_X" position. If that is not the case, notify the C&M Manager.

6.3 Other visual inspections are included as part of the test preparation or test procedure.

7. Test Article Preparation

The Site Operator is responsible for ensuring that all steps labeled "Site Operator" in Section 7 of TP 707 or TP 710 have been completed.

These steps include CVS function tests, CVS and analyzer bench leak checks, verification that the power is on for all required instruments, activation of the LCS-TAP program, and verification of the analyzer span points.

Section 7 steps are performed daily at the beginning of each shift.

7.1 Verify that the flow rate for each analyzer is set to the posted required flow rate in each of the following analyzer modes: Zero, Span, and Analysis (Anal).

7.1.1 Push the Soltec recorder pen selector button to the center position to prevent damage to the recorder.

7.1.2 Select "Zero" for each analyzer.

7.1.3 Verify that the zero gas flow rates are set to the posted required flow rates for each analyzer; adjust them if necessary.

7.1.4 Select "Span" for the highest range on each analyzer.

7.1.5 Verify that the span-gas flow rates are set to the posted required flow rates for each analyzer; if the zero-gas and span-gas flow rates do not match, notify the C&M Manager.

7.1.6 Select "Span" for the next lower range for each analyzer.

7.1.7 Verify that the span-gas flow rates are set to the posted required flow rates for each analyzer; if the zero-gas and span-gas flow rates do not match, notify the C&M Manager.

7.1.8 Repeat Steps 7.1.6 and 7.1.7 until all span-gas flow rates have been verified for each analyzer.

7.1.9 Select "Zero" for each analyzer.

7.1.10 Select the Front Panel Connector (FPC) button on the CVS Sample Control.

7.1.11 Insert the quick disconnect fitting into the "Sample" port located on the analyzer control unit front panel.

7.1.12 Select the “ANAL” buttons for all analyzers to sample room air.

7.1.13 Verify that the “Analysis” gas flow rates are set to the posted required flow rates for each analyzer; if the zero-gas, span-gas, and analysis-gas flow rates do not match, notify the C&M Manager.

Do not proceed if the flow rates do not match.

7.1.14 Select “Zero” for each analyzer.

7.1.15 Remove the quick disconnect fitting from the “Sample” port.

7.1.16 Push the Soltec recorder pen selector button to the “Record” position.

7.2 Using the LCS-TAP Program:

The LCS-TAP program reads the voltage signal from each analyzer and converts those readings into gas concentrations. The concentrations for HC, NO_X , HCO, LCO, and CH_4 are in parts per million (ppm), and the concentrations for CO_2 are in percent (%).

For the TAP program to correctly read analyzer calibrations and samples, the analyzer output must be stable for a minimum of 30 seconds.

A stable reading is 30 seconds of measurement (1 cm on the strip chart when operated at 2 cm/minute) in which the maximum and minimum points differ by no more than 1% of full scale.

Readings that are flagged by TAP must be addressed by the Site Operator according to the Operator Response instructions in the TAP Flag Directory (TFD).

Location of “Read” button and “Sample” Indicator Light:

On the LCS-TAP Control Panel, the “Read” button is located at the extreme left of the bottom row of buttons/lights. The “Sample” light (blue) is located in the center of the top row of buttons/lights.

7.2.1 Reading analyzer calibrations or samples:

Throughout the calibration and sample analysis process, use the following procedure to take a reading of analyzer calibrations or samples whenever the “Press the LCS-TAP Read Button” instruction is indicated:

7.2.2 Press the “Read” button until the “Sample” light (blue) is illuminated.

7.2.3 Check the LCS-TAP terminal printout to ensure that TAP accepted the readings. TAP will not print any values for a reading that is not accepted.

If the Site Operator attempts to take a reading when an analyzer is not stable, TAP will flag the reading as unacceptable with the following warning message:

[GAS] UNSTABLE DURING READ.

If any readings are not accepted, ensure that the analyzer traces are stable and press the “Read” button until the “Sample” light is illuminated.

7.2.4 Repeat this procedure four more times if necessary to obtain accepted TAP readings.

7.2.5 If readings are not accepted after a total of five attempts, notify VT supervisory personnel.

7.3 Multiple Range Calibration:

This procedure utilizes the Multiple Range Calibration (MRC) process, which allows the Site Operator to calibrate all required analyzer ranges for a test prior to the exhaust and background sample analysis.

For the MRC to function properly, all analyzers must be “tuned” so that the available calibration ranges are aligned with each other. This alignment sets up the analyzer ranges so that when zero or span is selected on any given range, the reading is within a specified tolerance without requiring zero or span potentiometer adjustment.

The alignment tolerances for the MRC are:

Zero: -2% to +5% full scale (FS) from zero.

Span: -5% to +8% FS from the posted span point.

If the Site Operator attempts to take a reading for zero or span and it is out of tolerance, TAP will flag the reading with the following warning message:

[NUMBER%] [GAS] DIF FRM CALPT.

When pre-calibrating, if any analyzer ranges are not aligned within these tolerances, notify the C&M Manager to have the ranges on that analyzer aligned.

If C&M is unable to align the ranges within the tolerances prior to test, testing may proceed using the non-MRC calibration procedure for the analyzers that exceed MRC tolerances.

Contact the Quality Control Group for a copy of a non-MRC procedure.

7.4 The methane analyzer requires a specified delay time before analysis can be attempted. When attempting to take a calibration or sample reading, the Site Operator must wait until the methane analyzer output is stable for at least 30 seconds.

If the Site Operator attempts to take a reading before the methane analyzer has completed its delay cycle, TAP will flag the reading with the following warning message :

CH_4 STILL WAITING FOR DELAY.

7.5 The strip chart provides a graphic representation of analyzer operation which can be used as a guide for analyzer zero and span adjustments. The TAP printout is the official reading used for calibration and emission data. The strip chart reading must be within 0.5 chart deflection of the TAP printout value for each analyzer.

If this tolerance is exceeded, notify the C&M Manager.

7.6 Analyzer pre-calibration ensures that the analyzers are functioning properly and verifies that the ranges are properly aligned for the MRC prior to the start of the testing.

7.7 Set each individual analyzer range attenuator to the lowest range available as follows:

HC = 14 NO_X = 15 CO_2 = 22 LCO = 16 HCO = 20 CH_4 = 14

7.7.1 Select “Zero” on the AMS for each analyzer.

7.7.2 Adjust each analyzer zero potentiometer until the zero gas readings are within the initial zero pre-calibration tolerance of ±0.2% FS. This tolerance is only for setting the lowest range.

If adjustment is necessary, unlock the zero potentiometers by raising the locking lever.

7.7.3 Press the LCS-TAP "Read" button.

7.8 Select "SPAN" on the AMS for each analyzer.

HC = 14 NO_X = 15 CO_2 = 22 LCO = 16 HCO = 20 CH_4 = 14

7.8.1 Adjust each analyzer span potentiometer until the span readings are within the initial span pre-calibration tolerance of ±0.2% FS from the span point. This tolerance is only for setting the lowest range.

If adjustment is necessary, unlock the span potentiometers by raising the locking lever.

7.8.2 Press the LCS-TAP "Read" button.

7.9 Select "Zero" on the AMS for each analyzer. Do not adjust the zero potentiometers.

7.9.1 Press the LCS-TAP "Read" button.

7.9.2 Check each analyzer zero reading; if the readings are out of pre-calibration tolerances, return to Step 7.7.

If after three attempts you are unable to obtain an acceptable zero check, contact the C&M supervisor.

7.10 Set each individual analyzer range attenuator to the next higher range as follows:

HC = 16 NO_X = 17 CO_2 = 23 LCO = 18

7.10.1 Select "Zero" on the AMS for each analyzer (if not already selected). Do not adjust the zero potentiometers.

7.10.2 Press the LCS-TAP "Read" button.

7.10.3 Check each analyzer zero reading; if the readings are out of the MRC zero calibration alignment tolerance of -2% to +5% FS the [NUMBER%] [GAS] DIF FRM CALPT flag will appear. Notify C&M that a range alignment is required.

If C&M is unable to complete the range alignment prior to testing, revert to the non-MRC calibration procedure for that gas analyzer.

7.11 Select "SPAN" on the AMS for each analyzer. Do not adjust the span potentiometers.

7.11.1 Verify that the following span gases are selected:

HC = 16 NO_X = 17 CO_2 = 23 LCO = 18

7.11.2 Press the LCS-TAP "Read" button.

7.11.3 Check each analyzer span reading; if the readings are out of the MRC span calibration alignment tolerance of -5% to +8% FS from the posted span point the [NUMBER%] [GAS] DIF FRM CALPT flag will appear. Notify C&M that a range alignment is required.

If C&M is unable to complete the range alignment prior to testing, revert to the non-MRC calibration procedure for that gas analyzer.

7.12 Select "Zero" on the AMS for each analyzer. Do not adjust the zero potentiometers.

7.12.1 Press the LCS-TAP "Read" button.

7.12.2 Check each analyzer zero reading; if the readings are out of the calibration tolerance of ±2% FS from the zero set-point, return to Step 7.10.

If after three attempts you are unable to obtain an acceptable zero check, contact the C&M supervisor.

Note: The term "set-point" is the value that TAP has recorded indicating the point at which the analyzer zero and span calibrations are set by the technician. These points may be different than the posted span points or zero.

7.13 Set each individual analyzer range attenuator to the next higher range available as follows:

HC = 19 HCO = 22 CO_2 = 24

7.13.1 Select "Zero" on the AMS for each analyzer (if not already selected). Do not adjust the zero potentiometers.

7.13.2 Press the LCS-TAP "Read" button.

7.13.3 Check each analyzer zero reading; if the readings are out of the MRC zero calibration alignment tolerance of -2% to +5% FS the [NUMBER%] [GAS] DIF FRM CALPT flag will appear. Notify C&M that a range alignment is required.

If C&M is unable to complete the range alignment prior to testing, revert to the non-MRC calibration procedure for that gas analyzer.

7.14 Select "SPAN" on the AMS for each analyzer. Do not adjust the span potentiometers.

HC = 19 HCO = 22 CO_2 = 24

7.14.1 Press the LCS-TAP "Read" button.

7.14.2 Check each analyzer span reading; if the readings are out of the MRC span calibration alignment tolerance of -5% to +8% FS from the posted span point the [NUMBER%] [GAS] DIF FRM CALPT flag will appear. Notify C&M that a range alignment is required.

If C&M is unable to complete the range alignment prior to testing, revert to the non-MRC calibration procedure for that gas analyzer.

7.15 Select "Zero" on the AMS for each analyzer. Do not adjust the zero potentiometers.

7.15.1 Press the LCS-TAP "Read" button.

7.15.2 Check each analyzer zero reading; if the readings are out of the calibration tolerance of ±2% FS from the zero set-point, return to Step 7.10.

If after three attempts you are unable to obtain an acceptable zero check, contact the C&M supervisor.

8. Test Procedure

The following steps are performed concurrently with TP 707, TP 710, or one of the other exhaust sample collection procedures. The exhaust and background (dilution air) samples from the collection phase(s) of the procedure are transferred at the end of each phase to the analytical system for analysis.

100 Analyzer Calibration

101 Place the analyzer label on the strip chart and record the following information:

Date

Strip Chart Equipment Tracking (ET) Number

Dyno Number(s)

Test Number(s)

Vehicle Identification Number(s)

Technician Identification Number

102 Label the strip chart with the following standard markings as each step is performed to indicate:

the initial zero calibration (set point) - the number “zero” (0)

the initial span calibration (set point) - the word “SPAN”

a zero calibration or verification check - the number “zero” with a check mark (√)

a span verification check - the word “SPAN” with a check mark (√)

the background sample reading - the phase number (1, 2, or 3) and the letter “B”

the exhaust sample reading - the phase number (1, 2, or 3) and the letter “S”

103 Select “Zero” on the AMS for each analyzer (if not already selected).

104 Set each individual analyzer range attenuator to the lowest range available for sample analysis as follows:

HC = 14 NO_x = 15 CO_2 = 22 LCO = 16 HCO = 20 CH_4 = 14

105 Adjust each analyzer zero potentiometer until the zero gas readings are within the initial zero calibration tolerance of ±0.2% FS (lowest range only).

106 Press the LCS-TAP "Read" button.

107 If the zero readings are within the initial zero calibration tolerance, lock the zero potentiometers by pressing the locking levers down. If they are not within tolerance, go to Step 105.

108 Select "SPAN" on the AMS for each analyzer:

HC = 14 NO_x = 15 CO_2 = 22 LCO = 16 HCO = 20 CH_4 = 14

109 Adjust each analyzer gain potentiometer until the span readings are within the initial span calibration tolerance of ±0.2% FS (lowest range only).

110 Press the LCS-TAP "Read" button.

111 If the span readings are within the initial span calibration tolerance, lock the span potentiometers by pressing the locking levers down. If they are not within tolerance, go to Step 109.

112 Select "Zero" on the AMS for each analyzer. Do not adjust the zero potentiometers.

113 Press the LCS-TAP "Read" button.

114 Check each analyzer zero reading; if the readings are out of the calibration tolerances of ±2% of FS from the initial zero set-point, return to Step 103.

If after three attempts you are unable to obtain an acceptable zero check, notify C&M.

115 Set the individual analyzer range attenuator to the next higher range available as follows:

HC = 16 NO_x = 17 CO_2 = 23 LCO = 18

116 Select "Zero" on the AMS for each analyzer (if not already selected). Do not adjust the zero potentiometers.

117 Press the LCS-TAP "Read" button.

118 Check each analyzer zero reading; if the readings are out of the MRC zero calibration alignment tolerance of -2% to +5% FS the [NUMBER%] [GAS] DIF FRM CALPT flag will appear. Notify C&M that a range alignment is required.

If C&M is unable to complete the range alignment prior to testing, revert to the non-MRC calibration procedure for that gas analyzer.

119 Select “SPAN” on the AMS for each analyzer. Do not adjust the span potentiometers.

HC = 16 NO_x = 17 CO_2 = 23 LCO = 18

120 Press the LCS-TAP “Read” button.

121 Check each analyzer span reading; if the readings are out of the MRC span calibration alignment tolerance of -5% to +8% FS from the posted span point the[NUMBER%] [GAS] DIF FRM CALPT flag will appear. Notify C&M that a range alignment is required.

If C&M is unable to complete the range alignment prior to testing, revert to the non-MRC calibration procedure for that gas analyzer.

122 Select “Zero” on the AMS for each analyzer. Do not adjust the zero potentiometers.

123 Press the LCS-TAP “Read” button.

124 Check each analyzer zero reading; if the readings are out of the calibration tolerance of ±2% FS from the zero set-point, return to Step 115.

If after three attempts you are unable to obtain an acceptable zero check, contact the C&M supervisor.

125 If a vehicle is known or suspected to require high analyzer ranges, e.g. HC-19, HCO-22, or CO_2-24, select and calibrate those ranges as necessary.

Otherwise proceed to Step 200.

126 Set the individual analyzer range attenuator to the next higher range available as follows:

HC = 19 HCO = 22 CO_2 = 24

127 Select “Zero” on the AMS for each analyzer (if not already selected). Do not adjust the zero potentiometers.

128 Press the LCS-TAP “Read” button.

129 Check each analyzer zero reading; if the readings are out of the MRC zero calibration alignment tolerance of -2% to +5% FS the [NUMBER%] [GAS] DIF FRM CALPT flag will appear. Notify C&M that a range alignment is required.

If C&M is unable to complete the range alignment prior to testing, revert to the non-MRC calibration procedure for that gas analyzer.

130 Select "SPAN" on the AMS for each analyzer. Do not adjust the span potentiometers.

HC = 19 HCO = 22 CO_2 = 24

131 Press the LCS-TAP "Read" button.

132 Check each analyzer span reading; if the readings are out of the MRC span calibration alignment tolerance of -5% to +8% FS from the posted span point the [NUMBER%] [GAS] DIF FRM CALPT flag will appear. Notify C&M that a range alignment is required.

If C&M is unable to complete the range alignment prior to testing, revert to the non-MRC calibration procedure for that gas analyzer.

133 Select "Zero" on the AMS for each analyzer. Do not adjust the zero potentiometers.

134 Press the LCS-TAP "Read" button.

135 Check each analyzer zero reading; if the readings are out of the calibration tolerance of ±2% FS from the zero set-point, return to Step 126.

If after three attempts you are unable to obtain an acceptable zero check, contact the C&M supervisor.

200 Exhaust Sample Analysis

(1) As soon as possible following completion of each sample collection phase, measure the concentration of HC, NO_X, CO, CO_2, and if required, CH_4 in the exhaust samples. The process described in Sections 200 through 400 is repeated for each phase of the sample collection procedure used (TP 707, TP 710, or other procedure, as required). The exhaust sample must be analyzed within 20 minutes of the end of the bag fill time.

If LCS-TAP crashes during the course of the sample analysis process, review Attachment C, "Manual Analysis Procedure", to determine the proper course of action.

Note: All certification test vehicles require CH_4 analysis except during the Highway Fuel Economy Test.

201 Shake the exhaust sample bags for several seconds prior to analysis; this will reduce sample stratification and unstable sample readings.

202 Select the exhaust sample to be analyzed by pressing the appropriate CVS Control Unit buttons for that phase of the test as follows, ensuring that they are illuminated:

The green button V17 is for sample #1.

The blue button V18 is for sample #2.

The yellow button V19 is for sample #3.

When testing two vehicles at the same time, the vehicle that finishes the sample phase first will be analyzed first.

203 Select "D00N SAM" (where N = dyno number) on the CVS sample control.

204 Select "ANAL" on the AMS for each analyzer. Select "ANAL" for only one CO analyzer at a time.

If both CO analyzers are placed in the "ANAL" position and the Site Operator attempts to take a reading, TAP will flag the reading with the following warning message:

"ONLY USE ONE CO ANALYZER."

205 Set each individual analyzer range attenuator to the lowest range that will allow the exhaust sample reading to be less than 98% of full scale.

206 If the exhaust sample reading exceeds 100% of full scale and a higher range is not available, record the DVM reading on the strip chart.

207 Obtain a stable reading for each analyzer.

208 Press the LCS-TAP "Read" button.

209 On the strip chart, label the exhaust sample measurement area, marking off the portion of the trace representing the measurement as described in Step 102.

210 Close the exhaust sample bag valve by pressing the appropriate CVS Control Unit button as follows:

The green button V17 is for sample #1.

The blue button V18 is for sample #2.

The yellow button V19 is for sample #3.

211 Analyze the exhaust sample for a second vehicle, if there is a second vehicle, by repeating the steps in Section 200.

300 Background Sample Analysis

(1) The background sample bags should be analyzed as soon as possible following the analysis of the sample bags. Measure the concentration of HC, NO_X, CO, CO_2, and if required CH_4 in the background samples. There is no time limit for analysis of background bags.

If LCS-TAP crashes during the course of the sample analysis process, review Attachment C, "Manual Analysis Procedure", to determine the proper course of action.

301 Select the background sample to be analyzed by pressing the appropriate CVS Control Unit buttons for that phase of the test as follows, ensuring that they are illuminated:

The green button V14 is for background #1.

The blue button V15 is for background #2.

The yellow button V16 is for background #3.

The first background to be analyzed should correspond to the first vehicle exhaust sample that was analyzed.

302 Select “D00N B/G” (where N = dyno number) on the CVS sample control.

303 Select “ANAL” on the AMS for each analyzer.

304 Set each individual analyzer range attenuator to the lowest range.

If sample analysis occurred on the HCO analyzer, set it to the lowest range for background bag analysis. Do not use the LCO analyzer for background bag analysis if the sample was analyzed on the HCO analyzer.

305 Obtain a stable reading for each analyzer.

306 Press the LCS-TAP “Read” button.

307 On the strip chart, label the background sample measurement area, marking off the portion of the trace representing the measurement as described in Step 102.

308 Turn off the background sample bag valve by pressing the appropriate CVS Control Unit button as follows:

The green button V14 is for background #1.

The blue button V15 is for background #2.

The yellow button V16 is for background #3.

309 Analyze the background sample for a second vehicle, if there is a second vehicle, by repeating the steps in Section 300.

400 Analyzer Calibration Verification

All analyzer ranges used for analysis in Sections 200 and 300 must have their calibrations verified. Use the TAP printout as a guide to determine which ranges must be verified. Do not make any adjustments to the analyzer zero and span settings set in Section 100. If adjustments are made, all calibrations and analyses will need to be redone.

401 Analyzers should already be on the lowest ranges from the background sample bag analysis; if they are not, set each individual analyzer range attenuator to the lowest ranges used, as determined in Section 300.

402 Select “SPAN” on the AMS for each analyzer.

403 Press the LCS-TAP “Read” button.

404 On the strip chart, label the span verification check area, marking off the portion of the trace representing the span check as described in Step 101.

405 Set each individual analyzer range attenuator to the next higher range used, as determined in Sections 200 and 300.

406 Repeat Steps 402-405 until all ranges used for analysis have been span checked.

407 Analyzers should already be on the highest ranges used during the Span Verification Check; if they are not, set each individual analyzer range attenuator to the highest range used, as determined in Section 200.

408 Select “Zero” on the AMS for each analyzer.

409 Press the LCS-TAP “Read” button.

410 On the strip chart, label the zero verification check area, marking off the portion of the trace representing the zero check as described in Step 101.

411 Set each individual analyzer range attenuator to the next lower range used, as determined in Sections 200 and 300.

412 Repeat Steps 409 through 411 until all ranges used for analysis have been zero checked.

413 Calibration verifications that deviate by more than ±2.0% of full scale from the span set-point or the zero set-point calibration that precede the analysis are not valid.

If the Site Operator has performed a sample analysis and the following analyzer span or zero verification is out of tolerance by ±2% of FS from zero set-point or the span set-point, TAP will flag the reading with the following message:

[NUMBER%] [GAS] DIF FRM CALSET.

Exhaust and background samples for which the calibrations do not meet this specification require repeat analysis (Section 100 through 400). The repeat analysis of exhaust samples must be accomplished within the 20-minute time constraint.

If the calibration verifications do not meet the specification described in Section 400, (±2.0% of full scale) notify VT supervisory personnel.

414 If the analysis time of any exhaust sample exceeds the 20-minute time limit, notify VT supervisory personnel.

415 Return to the sample collection procedure (TP 707 or TP 710) being used and complete the process as required.

416 Verify all calibration and measurement data are complete and accurate before entering the "SAVE" command on LCS-TAP.

9. Data Input

9.1 Fill out the following areas of Form 708-01:

Driver ID ..... Row C, Columns 14 - 18

Actual Inertia Setting ..... Row C, Columns 28 - 32

Indicated Dyno HP ..... Row C, Columns 33 - 36

Odometer ..... Row C, Columns 37 - 42

Tire Pressure ..... Row C, Columns 43 - 46

CVS Unit ..... Row C, Columns 61 - 63

Fuel Container ID ..... Row H, Columns 40 - 45

9.2 Place the Analyzer Data sticker on the strip chart and record the following information:

Date

Equipment Tracking (ET) Number

Dyno Number(s)

Test Number(s)

Vehicle Identification Number(s)

Technician Identification Number

9.3 On the analyzer strip chart, the Site Operator labels the following events using the labeling conventions listed in Step 102: Each zero calibration, span calibration, zero calibration check, and zero or span verification check. Each exhaust sample reading and background sample reading area.

9.4 TAP flags are addressed during the test according to the TAP Flag Directory.

10. Data Analysis

The validation technician who performs the data analysis must be familiar with this procedure and should not have performed any of the preceding steps of this procedure or TP 707 or TP 710.

10.1 Strip chart

10.1.1 Verify that the strip chart label has been correctly filled out. Cross reference respective entries with Form 708-01.

10.1.2 Ensure that all analysis events have been correctly labeled. Labeling conventions are listed in Step 102 of this procedure.

10.1.3 If all the information is correct and the analysis events have been correctly labeled, sign and date in the validation section of the strip chart label.

If all the above items are not complied with, contact a VT senior technician.

10.2 TAP Printout

10.2.1 Ensure that all TAP flags have been addressed as described in the TAP Flag Directory.

10.2.2 Ensure that the saved data have no error stars or missing values in the summary section.

10.2.3 Verify that all samples were read within the 20-minute time limit.

10.2.4 Cross reference dyno and vehicle ID information with the VDA summary report to ensure that the correct test number was assigned to the dyno.

10.2.5 If all the items in Steps 10.2.1 through 10.2.4 have been complied with, write “OK,” your technician ID number, and the date at the bottom of the TAP printout.

If all the items were not complied with, contact a VT senior technician.

10.3 Form 708-01

10.3.1 Review Rows C and H to ensure that all the following information has been entered correctly:

Driver ID ..... Row C, Columns 14 - 18
Actual Inertia Setting ..... Row C, Columns 28 - 32
Indicated Dyno HP ..... Row C, Columns 33 - 36
Odometer ..... Row C, Columns 37 - 42
Tire Pressure ..... Row C, Columns 43 - 46
CVS Unit ..... Row C, Columns 61 - 63
Fuel Container ID ..... Row H, Columns 40 - 45

10.3.2 If all the information is correct, enter your technician ID number in Row H, Columns 16 -20. If any of the information is incorrect, contact a VT senior technician.

11. Data Output

The following items listed in this section are to be placed in the Test Packet. Shared data items, such as the analysis strip chart, shall be placed in the test packet with the lowest test number. The technician will then complete Form 801-01 and place it in the other test packet.

11.1 Analysis strip chart

11.2 TAP printout

11.3 Form 708-01

11.4 The LCS and MTS Light-Duty System software are used to process the input data, generating the following:

"Light Duty Vehicle Analysis Report"

"Light Duty Vehicle Analysis Quality Control Report"

"Light Duty Vehicle Emissions Test Data Sheet Image"

12. Acceptance Criteria

12.1 The zero set-points must be within -2% to +5% of FS from zero.

12.2 The zero checks must be within ±2% of FS from the zero set-point that preceded the analysis.

12.3 The span set-points must be within -5% to +8% of FS from the posted span points.

12.4 The span checks must be within ±2% of FS from the span set-points that preceded the analysis.

12.5 Every range used for analysis must have span and zero verification checks prior to saving the test on TAP.

12.6 Exhaust sample bags must be analyzed within 20 minutes of the end of the bag fill time for each phase of the test. TAP and the automatic bag timers monitor the elapsed time between completion of the sample collection and completion of the sample analysis.

(1) 12.7 For each phase of the test the zero, span, sample, and verification readings must all be taken in the same manor, i.e., all by TAP or all by the manual method.

13. Quality Provisions

13.1 The strip chart recorder mechanical zeros are verified prior to each test as described in TP 707.

13.2 For each analyzer used, the flow rates for zero, span, and sample gases are set such that the flow rates remain the same for each position selected.

13.3 TAP Quality Control level flags indicate that a statistical control limit has been exceeded. The operator must contact a senior technician to review the TAP printout and recommend appropriate action.

The certification representative or project officer must then be contacted and a determination of valid, variant, or void will be made.

The operator will then complete and file Form 902-01, if necessary.

13.4 The site operator verifies that all electronic equipment is on and properly warmed up prior to use.

13.5 The analyzer operator checks verifies that the CVS sample flow rate for each phase of the UDDS is within 13-20 scfh at all times.

13.6 For each flag on the TAP printout, the technician that is validating the data certifies that the Site Operator followed the appropriate TAP Flag Directory instructions.

(1) 13.7 The strip chart recorder is calibrated monthly and verified monthly during calibration

13.8 The analyzer strip chart, Form 708-01, and the TAP printout are validated by a qualified technician, and the validator's ID number and, where applicable, the date and "OK," appear on the forms.

13.9 Deviations from this procedure are documented on Form 902-01. In general, these deviations will void the data. However, the customer may choose to accept the data as variant. To do this, the customer must indicate acceptance by signing and dating Form 902-01.

Zero/Span Offset Correction Formula

The Zero/Span Offset Correction Formula is used by the computer to correct readings where the zero and/or span calibrations are not within tolerance. This process may also be used to correct readings where manual analysis is used.

The formula is taken from Eric Zellin's Technical Report, "Software Zero and Span for a Laboratory Computer System," dated March 1982.

The simplified formula is as follows:

Corrected Reading = M ∗ (Zero Adjusted Sample Reading)

Zero Adjusted Sample Reading = (Sample Reading - Zero Reading)

$$\text{Where: } M = \frac{\text{Span Point}}{(\text{Span Reading - Zero Reading})}$$

The following is an example calculation of a zero and span correction for an analysis reading using this formula:

Span Point = 90.0 ..... This is the posted span point.
Zero Reading = 0.5 ..... This is the zero, which has been offset by 0.5 chart deflections.
Span Reading = 92.0..... This is the set span point, which is 2.0 deflections high.
Sam. Reading = 50.0 ..... This is the sample reading.

$$M = \frac{90.0}{(92.0\text{-}0.5)} = \frac{90.0}{91.5} = 0.983606557$$

Zero Adjusted Sample Reading = (50.0 - 0.5) = 49.5 Subtract the zero offset from sample reading.

Corrected Reading = 0.983606557 ∗ 49.5

Corrected Reading = 48.68852457 ..... This is the calculated value.

Rounded Reading = 48.7 ..... This is the value that would be entered.

The following is a second example calculation of a zero and span correction for an analysis reading using this formula with a negative zero value:

Span Point = 90.0 ..... This is the posted span point.
Zero Reading = - 0.5..... This is the zero, which has been offset by - 0.5 chart deflections.
Span Reading = 92.0..... This is the set span point, which is 2.0 deflections high.
Sam Reading = 50.0 ..... This is the sample reading.

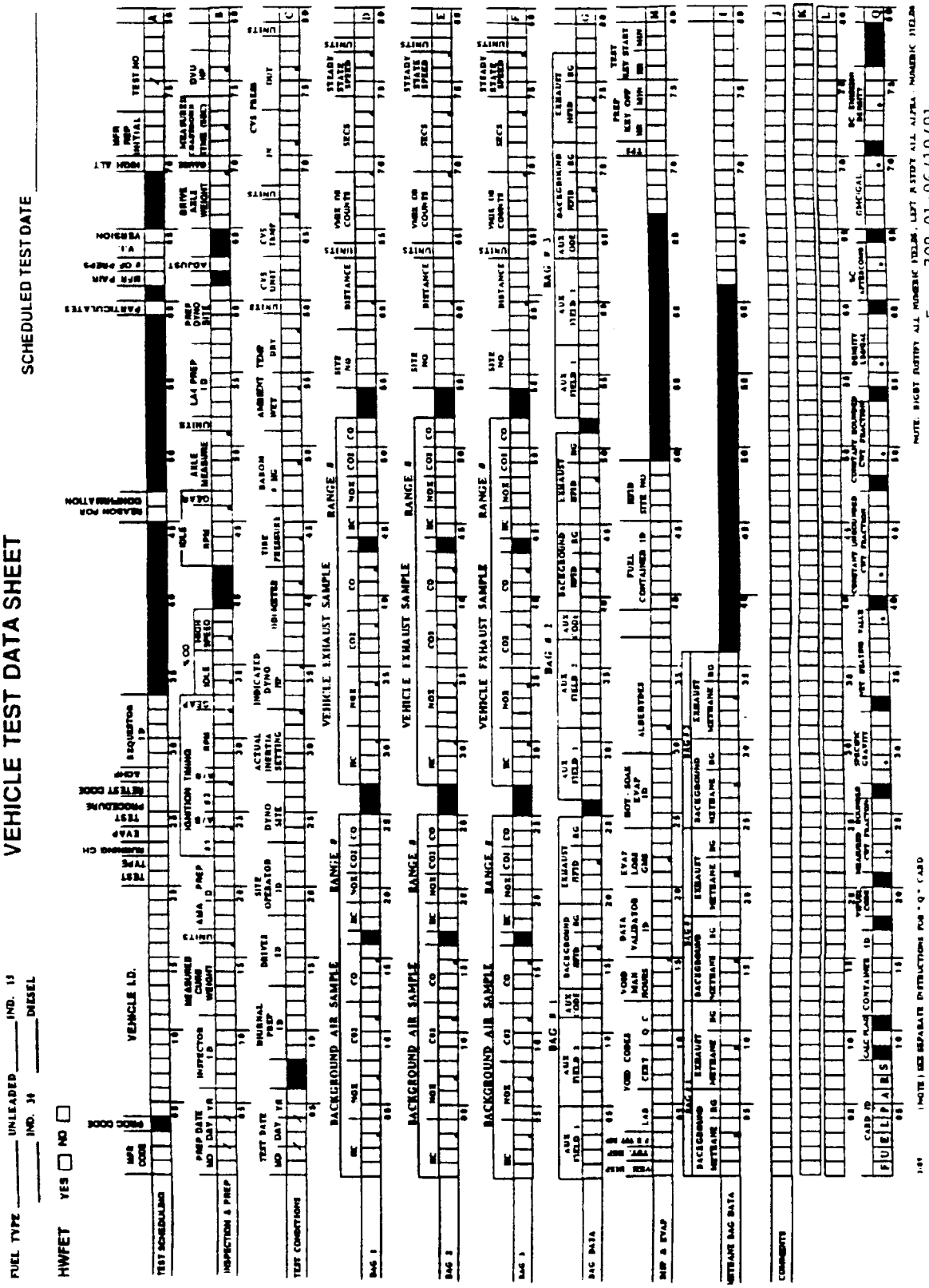
$$M = \frac{90.0}{(92.0 - (-0.5))} = \frac{90.0}{92.5} = 0.972972973$$

Zero Adjusted Sample Reading = (50.0 - (-0.5)) = 50.5 Subtract the zero offset from sample reading.

Corrected Reading = 0.972972973 ∗ 50.5

Corrected Reading = 49.135135137 ..... This is the calculated value.

Rounded Reading = 49.1 ..... This is the value that would be entered.


VEHICLE TEST DATA SHEET
SCHEDULED TEST DATE
FUEL TYPE
UNLEADED
IND. 13
IND. 14
DIESEL
HWFET
YES
NO
VEHICLE I.D.
TEST SCHEDULING
INSPECTION & PREP
TEST CONDITIONS
BACKGROUND AIR SAMPLE
VEHICLE EXHAUST SAMPLE
BAG 1
BAG 2
BAG 3
BAG DATA
EVAP
METHANE BAG DATA
COMMENTS
FUEL LABS
Form 708-01:06/10/91

Manual Analysis Procedure

If TAP crashes during a test, the strip chart will be the official record of the data. Use it to set analyzer zeros and spans, record the sample and background bag analysis, and indicate elapsed time.

Set the analyzer strip chart speed to 2 cm/minute and allow it to continuously record the readings through the remainder of the sample analysis and zero/span process. Do not stop the trace until all sample analysis and zero/span checks are completed.

On the analyzer strip chart, immediately record the official time displayed on the Master Clock. Mark the trace with a horizontal line to indicate where the data are being recorded at this time. This will provide an accurate record of time to determine compliance with the 20-minute sample analysis limit. These steps are critical. If not done, there is no way to confirm that time limits are within tolerance.

Verify that all sample analyses that were performed on TAP prior to the crash have span and zero verifications for each range. If these verifications were not performed using TAP, and if the 20-minute time limit has not been exceeded, it will be necessary to perform Steps 1 through 15 to analyze the sample bags again.

The zero, span, sample, and verification readings must all be taken in the same manor, i.e., all by TAP or all by the manual method. If sample bags were read using TAP and the span and zero verifications were not performed prior to the TAP crash and you do not have time (i.e., the 20-minute bag limit will be exceeded) to complete Steps 1 through 8 for those sample bags, the test is void. Steps 9 through 15 do not need to be completed within the 20-minute tolerance.

If the zero, span, sample, and verification readings were performed using TAP, and it has crashed, you may analyze the remaining sample and background bags as follows:

1. Set each individual analyzer range attenuator to the lowest range available. If you know the ranges originally used on TAP for analysis, set the analyzers to those ranges.

2. Select “Zero” on the Analyzer Mode Selector (AMS) for each analyzer. Adjust each analyzer zero potentiometer until the zero gas readings are within ±0.2% full scale (FS) for the selected ranges. On the strip chart, label the zero setting area.

3. Select the corresponding “SPAN” on the AMS for each analyzer. Adjust each analyzer span potentiometer until the span readings are within ±0.2% FS of the posted span point. On the strip chart, label the span area with the ranges selected and their corresponding posted span points.

4. Select “Zero” on the AMS for each analyzer. Do not adjust the zero potentiometers. On the strip chart, label the zero setting area.

5. Verify that these analyzer zero readings are within ±0.2% FS. If not, repeat Steps 1 through 4 until all settings are within the tolerances.

6. Select “D00N SAM” (where N = dyno number) on the CVS sample control.

7. Select the exhaust sample to be analyzed by pressing the appropriate CVS Control Unit buttons for that phase of the test.

   The green button V17 is for sample #1.

   The blue button V18 is for sample #2.

   The yellow button V19 is for sample #3.

8. Select “ANAL” on the AMS for each analyzer. Obtain a stable reading, as described in Step 7.2, for each analyzer. On the strip chart, label the exhaust sample measurement area.

9. Select “D00N B/G” (where N = dyno number) on the CVS sample control.

10. Select the background sample to be analyzed by pressing the appropriate CVS Control Unit buttons for that phase of the test.

    The green button V14 is for background #1.

    The blue button V15 is for background #2.

    The yellow button V16 is for background #3.

11. Obtain a stable reading for each analyzer. On the strip chart, label the background measurement area.

12. Select “SPAN” on the AMS for each analyzer. Do not adjust the span potentiometers. On the strip chart, label the span verification check area.

13. Verify that the readings are within ±2.0% of full scale from the posted span set-point. Span verifications that deviate by more than ±2.0% of the posted span point are not valid. If the 20-minute time limit has not been exceeded, repeat Steps 1 through 12. If unable to obtain a valid span verification, notify VT supervisory personnel.

14. Select “Zero” on the AMS for each analyzer. Do not adjust the zero potentiometers. On the strip chart, label the zero setting area.

15. Verify that the readings are within ±2.0% of full scale from the zero set-point. Analyzer zero verifications that deviate by more than ±2.0% of full scale are not valid. If the 20-minute time limit has not been exceeded, repeat Steps 1 through 14. If unable to obtain a valid zero verification, notify VT supervisory personnel.

If higher ranges are needed, repeat Steps 1 through 15 for those sample bags. All exhaust samples must be read within 20 minutes of the end of their corresponding sample collection, background bags are excluded from this time limit.

Tap Flag Directory

The purpose of this directory is to provide a guide for addressing flag messages from the "Laboratory Computer System (LCS) Test Analysis Processor (TAP)." The LCS-TAP program is used to monitor and record data from the collection and subsequent analysis of gaseous emissions in the exhaust of Light Duty Vehicles during a chassis dynamometer test run. The TAP Flag Directory listing is a compilation of the most frequently occurring TAP Flags.

Please note that the TAP Flag Directory is Attachment D in TP 708 and the first page of this document does not have a number, other than that assigned in the procedure (Page 30 of 30). As is standard practice, the title page of a book or manual is not numbered, therefore, the directory page numbering starts with the table of contents with the letter i through iii. The remaining pages of the directory are numbered 1 through 46.

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Definitions

Operator

For the purposes of this document, the operator is defined as the person who is operating the Sample Collection/Analysis System.

Data Technician

For the purposes of this document, the data technician is defined as the person responsible for ensuring that the test data are accurate and that all flags have been addressed.

Senior Technician

For the purpose of this document, the senior technician is defined as the person responsible for ensuring that the testing meets all Code of Federal Regulations (CFR) and Engineering Operations Division (EOD) procedures.

[gas]

For the purpose of this document, [gas] could be Hydrocarbon (HC), Oxides of Nitrogen (NO_x), Carbon Dioxide (CO_2), Carbon Monoxide (CO), or Methane (CH4).

[bag#]

For the purpose of this document, [bag#] could be 1B, 2B, 3B, 1E, 2E, or 3E. The "B" indicates a background bag and the "E" indicates an exhaust bag.

[number]

For the purpose of this document, [number] is the actual value read or a percentage calculated by TAP.

[zero / span]

For the purpose of this document, [zero / span] will be "ZERO" for zero gas, "SPAN" for span gas or "Z & S" for zero and span gas.

Note: The symbols < > are used to indicate a key on the keyboard.

Example: Push <1> to start. This means that you need to push the key labeled "1" to start the equipment.

TAP Flag Category Descriptions

Ambient

These flags concern test cell ambient conditions involving the temperature and/or the dew-point temperature, which is a measurement of humidity.

Analyzer

These flags concern analyzer functions including: calibration, calibration verification, and related procedures.

Bags

These flags concern bag collection and analysis functions including: exhaust sample concentration, background concentration, fill times, and related procedures.

LCS

These flags concern the Laboratory Computer System (LCS) data acquisition functions.

Roll Revs

These are statistical limit flags concerning the dynamometer distance function.

CVS

These flags concern the control of Constant Volume Sampler (CVS) functions.

VMIX

These are statistical limit flags concerning the CVS Volume of Sample Mixture (VMIX) function.

TAP Flag Severity Levels

Procedural (P)

Procedural level flags indicate that a CFR or EOD procedural violation has occurred. The operator should contact a senior technician to review the TAP printout and recommend appropriate action. The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made. The analyzer operator will then complete and file Form 902-01, if necessary.

Quality Control (QC)

Quality Control level flags indicate that a statistical control limit has been exceeded. The operator should record specified additional data. The operator should contact a senior technician to review the TAP printout and recommend appropriate action. The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made. The operator will then complete and file Form 902-01, if necessary.

Advisory (A)

Advisory level flags notify the operator that an error in the test process has occurred. These conditions require minimal corrective action by the operator. Examples of corrective actions would be to take another reading or correct a previous entry.

Warning (W)

Warning level flags notify the operator that statistical control limits are being approached or that an error condition has occurred and corrective action is required. The technician performing the data verification should confirm that the operator completed the proper corrective action.

Notice (N)

Notice level flags provide information to the operator to assist him/her in the performance of a test. The required operator response is minimal or none.

Flag Example

Category & Number	Severity Level	Flag Description
Analyzer 1	**A**	**[gas] UNSTABLE DURING READ**

This section provides the analyzer operator with a description of the conditions that could cause flags to appear.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

The purpose of this section is to ensure the analyzer operator takes corrective actions: e.g., who needs to be notified, equipment checks, and documentation requirements, including labeling of TAP printouts and completion of Form 902-01, if necessary.

Note: The requirements of this section are not always performed immediately, especially in regard to documentation and notification.

Data Technician Response:

This section provides the technician with information needed to verify that the correct response was taken by the analyzer operator. A data technician response is not required for all flags.

Ambient Flags

Ambient 1 W FAST CHANGE TDB1

The test cell ambient temperature is measured using two thermocouples, Temperature Dry Bulb 1 (TDB1) and Temperature Dry Bulb 2 (TDB2). This flag indicates that a higher than normal rate of change is measured by TDB1.

The condition could be the result of a test cell air handling system control problem, unusual test cell air flow patterns caused by a vehicle's engine air being diverted across the thermocouples, or an electronic ambient temperature measurement system malfunction.

If this flag is accompanied by the TDB'S DIFFER flags (Ambient 3 or 4), it is usually caused by vehicle engine air being diverted across the thermocouples. This condition should be verified.

Operator Response:

Determine if both TDB1 and TDB2 are giving similar flags. Using the LCS keyboard, check TDB1 and TDB2 readings by pressing <BREAK>, <A>, and then press <RETURN>. TAP will print the ambient conditions. Compare the two readings.

If both TDB1 and TDB2 are indicating fast change flags, and there is no evidence of warm engine air being diverted across the thermocouples, the flags could possibly be caused by temperature fluctuations in the test cell air handling system.

If these checks, combined with a physical sense of temperature changes, indicate that there is a problem with the test cell air handling system, immediately contact the building maintenance services.

If there is evidence of vehicle engine air being diverted across the thermocouples, document this condition on the TAP printout.

If only one ambient thermocouple indicates a fast change, the problem could be an electronic malfunction and C&M should be notified.

Document all observations and actions on the TAP printout.

Data Technician Response:

Ensure that a clear, concise description of conditions and action taken is written on the TAP printout**.**

Ambient Flags

Ambient 2 W FAST CHANGE TDB2

The test cell ambient temperature is measured using two thermocouples, Temperature Dry Bulb 1 (TDB1) and Temperature Dry Bulb 2 (TDB2). This flag indicates that a higher than normal rate of change is measured by TDB2.

The condition could be the result of a test cell air handling system control problem, unusual test cell air flow patterns caused by a vehicle's engine air being diverted across the thermocouples, or an electronic ambient temperature measurement system malfunction.

If this flag is accompanied by the TDB'S DIFFER flags (Ambient 3 or 4), it is usually caused by vehicle engine air being diverted across the thermocouples. This condition should be verified.

Operator Response:

Determine if both TDB1 and TDB2 are giving similar flags. Using the LCS keyboard, check TDB1 and TDB2 readings by pressing <BREAK>, <A>, and then press <RETURN>. TAP will print the ambient conditions. Compare the two readings.

If both TDB1 and TDB2 are indicating fast change flags, and there is no evidence of warm engine air being diverted across the thermocouples, the flags could possibly be caused by temperature fluctuations in the test cell air handling system.

If these checks, combined with a physical sense of temperature changes, indicate that there is a problem with the test cell air handling system, immediately contact the building maintenance services.

If there is evidence of vehicle engine air being diverted across the thermocouples, document this condition on the TAP printout.

If only one ambient thermocouple indicates a fast change, the problem could be an electronic malfunction and C&M should be notified.

Document all observations and actions on the TAP printout.

Data Technician Response:

Ensure that a clear, concise description of conditions and action taken is written on the TAP printout**.**

Ambient Flags

Ambient 3 W TDB'S DIFFER BY +1.5 F

The test cell ambient temperature is measured using two thermocouples, Temperature Dry Bulb 1 (TDB1) and Temperature Dry Bulb 2 (TDB2). This flag indicates that TDB1 is reading 1.5 °F (or more) higher than TDB2.

This flag can be caused by a vehicle's engine air being diverted across the thermocouples, or by one of the ambient temperature measurement system channels drifting out of calibration.

Operator Response:

Read TDB1 and TDB2 thermocouple measurements. Using the LCS keyboard, check TDB1 and TDB2 readings by pressing <BREAK>, <A>, and then press <RETURN>. TAP will print the ambient conditions. Compare the two readings.

If the readings are within 1.5 °F, the problem could be intermittently caused by engine air being diverted across the thermocouples. If this is the case, it should be documented on the TAP printout.

If there is no evidence of engine air being diverted across the thermocouples, and/or subsequent temperature readings of TDB1 continue to be 1.5 °F higher than TBD2, contact C&M.

Document all observations and actions on the TAP printout.

Data Technician Response:

Ensure that a clear, concise description of conditions and action taken is written on the TAP printout**.**

Ambient Flags

Ambient 4 W TDB'S DIFFER BY -1.5 F

The test cell ambient temperature is measured using two thermocouples, Temperature Dry Bulb 1 (TDB1) and Temperature Dry Bulb 2 (TDB2). This flag indicates that TDB1 is reading is 1.5 °F (or more) lower than TDB2.

This flag can be caused by a vehicle's engine air being diverted across the thermocouples, or by one of the ambient temperature measurement system channels drifting out of calibration.

Operator Response:

Read TDB1 and TDB2 thermocouple measurements. Using the LCS keyboard, check TDB1 and TDB2 readings by pressing <BREAK>, <A>, and then press <RETURN>. TAP will print the ambient conditions. Compare the two readings.

If the readings are within 1.5 °F, the problem could be intermittently caused by warm engine air being diverted across the thermocouples. If this is the case, it should be documented on the TAP printout.

If there is no evidence of engine air being diverted across the thermocouples, and/or subsequent temperature readings of TDB1 continue to be 1.5 °F lower than TBD2, contact C&M.

Document all observations and actions on the TAP printout.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Ambient 5 W TDB1 < 71.0 F

The test cell ambient temperature is measured using two thermocouples, Temperature Dry Bulb 1 (TDB1) and Temperature Dry Bulb 2 (TDB2). This flag indicates that the TDB1 ambient temperature is out of the normal range and is approaching the lower out-of-tolerance limit of 68 °F.

Operator Response:

Immediately contact the building maintenance services. Note the time of contact and conditions on TAP printout.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Ambient Flags

Ambient 6 P TDB1 < 68.0 F, VERIFY DATA

The test cell ambient temperature is measured using two thermocouples, Temperature Dry Bulb 1 (TDB1) and Temperature Dry Bulb 2 (TDB2). This flag indicates that the TDB1 ambient temperature has dropped below the CFR lower limit of 68 °F.

This flag should be preceded by Flag: Ambient 5 W: TDB1 < 71.0 F.

Operator Response:

Continue efforts to return the temperature to the normal range. Circle the flag message on the TAP printout and verify the accuracy of the reading.

Notify a senior technician and recommend appropriate action.

The certification representative or project officer should then be contacted and a determination of variant or void will be made.

The operator will then complete and file Form 902-01.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout.

Confirm that Form 902-01 has been properly completed.

Ambient 7 W TDB1 > 82.0 F

The test cell ambient temperature is measured using two thermocouples, Temperature Dry Bulb 1 (TDB1) and Temperature Dry Bulb 2 (TDB2). This flag indicates that the TDB1 ambient temperature is out of the normal range and is approaching the upper out-of-tolerance limit of 86 °F.

Operator Response:

Immediately contact the building maintenance services. Note the time of contact and conditions on the TAP printout.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Ambient Flags

Ambient 8 P TDB1 > 86.0 F, VERIFY DATA

The test cell ambient temperature is measured using two thermocouples, Temperature Dry Bulb 1 (TDB1) and Temperature Dry Bulb 2 (TDB2). This flag indicates that the TDB1 ambient temperature has exceeded the CFR upper limit of 86 °F.

This flag should be preceded by Flag: Ambient 7 W: TDB1 > 82.0 F.

Operator Response:

Continue efforts to return the temperature to the normal range. Circle the flag message on the TAP printout and verify the accuracy of the reading.

Notify a senior technician and recommend appropriate action.

The certification representative or project officer should then be contacted and a determination of variant or void will be made.

The operator will then complete and file Form 902-01.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout.

Confirm that Form 902-01 has been properly completed.

Ambient Flags

Ambient 9 W FAST CHANGE DEWP

The test cell humidity is measured using a optical condensation hygrometer, which reads in temperature DewPoint (DEWP). This flag indicates a high rate of change for the test cell dewpoint temperature.

This could be caused by humidity fluctuations in the test cell air handling system, or an electronic malfunction in the dew-point hygrometer or its signal conditioning channel to the LCS computer.

Operator Response:

Determine if the dew-point recorder trace or panel meter indicates a fast-changing output.

If so, the problem could be test cell humidity fluctuations or a dew-point hygrometer malfunction.

If no actual humidity changes can be detected by physical sensing, then the dew-point hygrometer would be suspect.

If instrument problems are suspected, C&M should be contacted.

If actual room humidity changes are detected, the building maintenance services should be contacted.

If the “FAST CHANGE DEWP” flag occurs while the room humidity feels normal and the dew-point output trace is normal, contact computer operations and request an LCS log entry to document the occurrence.

Note the time of contact and conditions on TAP printout.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout.

Ambient Flags

Ambient 10 W DEWP > 52.0 F

This flag indicates that the test cell dew-point temperature (humidity) is out of the normal range and will result in an abnormally high test humidity unless corrective action is taken immediately.

Operator Response:

Immediately contact the building maintenance services. Note the time of contact and conditions on the TAP printout.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout.

Ambient 11 W DEWP < 42.0 F

This flag indicates that the test cell dew-point temperature (humidity) is out of the normal range and will result in an abnormally low test humidity unless corrective action is taken immediately.

Operator Response:

Immediately contact the building maintenance services. Note the time of contact and conditions on the TAP printout.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout.

Ambient 12 N TOTAL DEWP RESET

This flag will not occur during the normal testing process. This flag indicates that TAP has been running for an extended period and that the test cell dew-point temperature computation process has reached an overflow point.

Operator Response:

No operator response is necessary.

Analyzer Flags

Analyzer 1 A [gas] UNSTABLE DURING READ

This flag indicates that the [gas] analyzer output does not meet the TAP stability criteria during the previous 30-second read period. A stable reading is 30 seconds of measurement (1 cm on the strip chart when operated at 2 cm/min) in which the maximum and minimum points differ by no more than 1% of full scale. TAP will not record unstable readings.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

Wait for at least 30 seconds of stable [gas] output on the recorder trace and take another reading.

If the [gas] analyzer trace does not stabilize within 2 minutes, check the settings and operating conditions.

Call C&M for assistance if the problem persists.

Analyzer 2 A [gas] RANGE CHANGED DURING READ

This flag indicates that the operator moved the [gas] range switch during the 30-second read period.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

Wait a minimum of 30 seconds after changing the [gas] range switch before pressing the read button. If the flag persists, contact C&M.

Analyzer Flags

Analyzer 3 A [gas] VALVE MOVED DURING READ

This flag indicates that the [gas] selector ball valves were moving during the 30-second read period.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

Wait a minimum of 30 seconds after the [gas] ball valves have stopped before pushing the read button. If the flag persists, contact C&M.

Analyzer 4 A [gas] ZERO/SPAN READINGS EQUAL

This flag indicates that the [gas] zero and span readings are equal. Some causes of this condition are an inoperative analyzer, no gas flow, or incorrect span or zero control settings.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

Determine the cause of the condition before initiating another [gas] read. If the cause cannot be determined, contact C&M.

Analyzer 5 W [number] % [gas] DIF FRM CALSET

This flag indicates that the [gas] zero or span has changed 2.0% or more of full scale from the calibration settings that preceded the analysis. This is a CFR violation.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4. The [number] is the actual percentage shift from the initial setting.

Operator Response:

All analyses performed prior to this flag without a valid calibration verification must be repeated. Set the [gas] analyzer(s) that are out-of-tolerance to within tolerance for zero and/ or span set points; see TP 708 for details. Analyze the background(s) and sample(s) for each analyzer and bag set effected. Perform a [gas] zero and span verification, see TP 708 for details. If this flag does not appear again, no further action is required.

If the 20 minute exhaust bag limit has not been exceeded, repeat this process until a valid calibration verification is obtained. There is no time limit for background bags.

If unable to analyze the sample within the 20 minute limit, notify the senior technician and C&M. Form 902-01 must be completed

Data Technician Response:

Verify that if the operator repeated the [gas] reading and that it is within tolerance. If not within tolerance, verify that the operator calibrated the [gas] analyzer and he/she performed a successful sample reading with a span and zero verification.

Analyzer Flags

Analyzer 6 W [number] % [gas] DIF FRM CALPT

This flag indicates that either the [gas] zero is not within -2.0% to +5.0% of full scale from zero or the [gas] span is not within -5.0% to +8% of full scale from the posted span point.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4. The [number] is the actual percentage shift from the posted span point.

Operator Response:

All analyses performed prior to this flag without a valid calibration verification must be repeated. Set the [gas] analyzer(s) that are out-of-tolerance to within tolerance for zero and/or span set points; see TP 708 for details. Analyze the background(s) and sample(s) for each analyzer and bag set effected. Perform a [gas] zero and span verification; see TP 708 for details. If this flag does not appear again, no further action is required. If the flag appears again, notify C&M.

Data Technician Response:

The Technician performing the data verification should confirm that the operator was able to perform a valid analysis.

Analyzer 7 W [gas] NO [zero / span] BEFORE ANALYSIS

This flag indicates that the required [gas] zero/span/zero calibration was not performed before the analysis. A zero/span/zero calibration must be performed prior to the analysis reading. This is a CFR requirement.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

All analyses performed prior to this flag without a valid calibration must be repeated. Set the [gas] analyzer(s) to within tolerance for zero and/or span set points; see TP 708 for details. Analyze the background(s) and sample(s) for each analyzer and bag set effected. Perform a [gas] zero and span verification; see TP 708 for details. If this flag does not appear again, no further action is required.

If the operator did perform a zero span zero calibration before the analysis but failed to read it on TAP, calibrate the [gas] analyzer using TAP, and reread the sample. If time is a factor, the background and sample readings may be taken from the strip chart and manually entered on Form 708-01, Vehicle Test Data Sheet, provided the zero and span were set within ±0.4 % of full scale.

If the zero and span are not within ±0.4 % of full scale but are within 2% and 5%, respectively, the sample and background readings are usable but will require correction. Follow the Zero/Span Offset Correction Formula and enter the corrected readings on Form 708-01. If the zero exceeded 2% of full scale from zero and/or the span exceeded 5% of full scale from the posted span point, the calibration is not valid. Notify a senior technician.

If the 20 minute exhaust bag limit has not been exceeded, calibrate the [gas] analyzer and read exhaust sample. There is no time limit for background bags.

Data Technician Response:

Verify that the operator successfully performed a zero/span/zero calibration.

Analyzer Flags

Analyzer 8 W [bag#] [gas] [zero / span] NOT CONFIRMED

This flag indicates that the [gas] zero and/or span readings were not confirmed after the analysis of [bag#]. This is a CFR requirement.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4 and the [bag#] could be 1B, 2B, 3B, 1E, 2E, or 3E.

Operator Response:

Perform [gas] span/zero verification readings after the background and sample analysis. If a reading was confirmed on the strip chart but not read on TAP, the operator should note on the TAP printout where the confirmation was performed.

Verify that the span and zero confirmations are within 2% of full scale of the calibration settings.

If the 20 minute exhaust bag limit has not been exceeded, calibrate the [gas] analyzer and read exhaust sample. There is no time limit for background bags.

If the test is void, notify the project officer or the certification representative. The technician will then complete and file Form 902-01.

Data Technician Response:

Verify that the operator successfully performed a zero and/or span reading confirmation.

If the test is void, confirm that Form 902-01 has been properly completed and filed.

Analyzer 9 W [gas] [zero / span] FROM PREVIOUS TEST # USED

This flag indicates that the [gas] zero/span from the previous test is being used by TAP for the bag analysis just performed. This flag appears when a zero/span for the present test has not been recorded by TAP since the current test number was entered.

If consecutive hot start tests are being run on the same vehicle, the previous zero and span checks may be used if less than 20 minutes has elapsed since the last calibration.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

If 20 minutes has elapsed since the last zero and span calibration, perform a [gas] zero, span, and zero calibration.

Data Technician Response:

Verify that the operator successfully performed a zero, span, and zero calibration for this test.

Analyzer Flags

Analyzer 10 A CH4 STILL WAITING FOR DELAY

This flag indicates that the required 50-second period has not elapsed since the methane (CH4) analyzer's ball valve change.

Operator Response:

Ensure that the methane analyzer trace is stable for a minimum of 50 seconds before pressing the read button. If the flag persists, contact C&M.

Analyzer 11 A CVS BAG CHANGED DURING READ

This flag indicates that the CVS bags have been switched during the 30-second read period.

Operator Response:

Wait for a minimum of 30 seconds after changing the CVS bag switch before pressing the read button. If the flag persists, contact C&M.

Analyzer 12 A BALL VALVES ARE STILL MOVING

This flag indicates that the ball valves were still moving at the time the read button was pushed.

Operator Response:

Wait for a minimum of 30 seconds after the ball valves have stopped moving, ensure that the analyzer trace is stable, then press the read button. If the flag persists, contact C&M.

Analyzer Flags

Analyzer 13 A INVALID BAG # FROM FPC

This flag indicates that an incorrect bag number has been entered from the LCS keyboard when using the front panel connector (FPC) as the source of the sample gas. When using the FPC, the TAP program will respond with the message:

">>ENTER FPC # (1/2/3) TYPE (B/E)"

Operator Response:

Specify the correct bag number (1, 2, or 3) and identify if the reading is a background (B) or exhaust (E) sample. It is possible that the FPC was mistakenly designated as the source; if so, designate the flow to one of the CVS ports, CVS1 or CVS2.

Analyzer 14 A INVALID BAG TYPE FROM FPC

This flag indicates that an incorrect bag type has been entered from the LCS keyboard when using the front panel connector (FPC) as the source of the sample gas. When using the FPC, the TAP program will respond with the message:

">>ENTER FPC # (1/2/3) TYPE (B/E)"

Operator Response:

Specify the correct bag number (1, 2, or 3) and identify if the reading is a background (B) or exhaust (E) sample. It is possible that the FPC was mistakenly designated as the source; if so, designate the flow to one of the CVS ports, CVS1 or CVS2.

Bag Flags

Bags 1 W [gas] CORR=[number] < 0.0

This flag indicates that the corrected (CORR) [gas] analysis reading is below zero. The negative reading will be corrected back to zero.

Some of the possible causes are: zero or span set out of tolerance, contaminated zero air, or equipment malfunction.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4. The [number] is the actual value less than zero.

Operator Response:

Verify the [gas] zero is set within ±2.0 % of full scale and the span is within ±5.0 % of full scale. If they are within tolerance, press the read button and analyze the sample.

If they are not within the tolerance, reset them and then analyze the [gas] sample. If the zero and span are within the tolerance limits and this flag repeats, contact C&M.

Note the observations and actions on the TAP printout.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Bags 2 W [gas] DEFL=[number] < -1.0

This flag indicates that the [gas] analysis is more than 1.0 deflection (DEFL) below zero. The negative reading will be corrected back to zero.

Some of the possible causes are: zero or span set incorrectly, contaminated zero air, or equipment malfunction.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4. The [number] is the actual value below -1.0 deflections. For this flag, 1.0 deflection equals 1.0 % of full scale.

Operator Response:

Verify the [gas] zero is set within ±2.0 % of full scale and the span is within ±5.0 % of full scale. If they are within tolerance, press the read button and analyze the sample.

If they are not within the tolerance, reset them and then analyze the sample. If the zero and span are within the tolerance limits and this flag repeats, contact C&M.

Note the observations and actions on the TAP printout.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Bag Flags

Bags 3 W [gas] DEFL=[number] >100.5

This flag indicates that the [gas] analyzer deflections (DEFL) have exceeded 100.5 % of full scale. TAP will accommodate readings up to 102.35% of full scale.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

Calibrate the next higher [gas] analyzer range. If a higher [gas] range is not available, and the reading is below 102.35, press the read button.

If a higher [gas] range is not available, and the reading is above 102.35, use the digital volt meter (DVM) located on the control panel to obtain a [gas] reading.

The [gas] reading is then manually entered on Form 708-01, Vehicle Test Data Sheet. In the Comments section of Form 708-01, note that the DVM was used to obtain the [gas] reading.

If the DVM was used, contact the certification representative or project officer to determine if variant test status is acceptable.

Document the variant condition in the Comments section of Form 708-01.

The operator will then complete and file Form 902-01.

If unable to determine a reason for the flag, contact a senior technician for a recommendation of appropriate action.

Data Technician Response:

Ensure that if the DVM was used to obtain a [gas] reading, it is manually entered on Form 708-01 and the variant condition is documented in the Comments section.

Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 4 W [gas] CORR=[number] >105

This flag indicates that the corrected (CORR) [gas] analyzer output has exceeded 105% of full scale. TAP will accommodate readings up to 102.35% of full scale.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

Calibrate the next higher [gas] analyzer range. If a higher [gas] range is not available, and the reading is below 102.35, press the read button.

If a higher [gas] range is not available, and the reading is above 102.35, use the digital volt meter (DVM) located on the control panel to obtain a [gas] reading.

The [gas] reading is then manually entered on Form 708-01, Vehicle Test Data Sheet. In the Comments section of Form 708-01, note that the DVM was used to obtain the [gas] reading.

If the DVM was used, contact the certification representative or project officer to determine if a variant test status is acceptable.

Document the variant condition in the Comments section of Form 708-01.

The operator will then complete and file Form 902-01.

If unable to determine what conditions caused the [gas] reading to exceed this limit, the operator should notify a senior technician for a recommendation of appropriate action.

Data Technician Response:

If the DVM was used to obtain a [gas] reading, ensure that it is manually entered on Form 708-01 and the variant condition is documented in the Comments section.

Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 5 QC BACKGROUND [bag#] [gas]=[number] >UPPER LIMIT

This flag indicates that the specified [gas] background bag level has exceeded the upper tolerance limit. High HC levels may indicate a fuel leak. If two or more background concentrations, such as High HC and CO exceed their limits, there may be an exhaust leak. Unusual background concentrations can be also caused by analyzer curve shifts, contaminated zero air, equipment problems, or sources outside of the test cell entering through the air handling system.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4 and the [bag#] could be 1B, 2B, or 3B.

Background concentration upper limits:

HC	2.3 PPM (propane)
NO_x	0.8 PPM
CO_2	0.050 %
LCO	2.5 PPM
HCO	12.0 PPM
CH_4	2.7 PPM

Operator Response:

If HC background concentrations exceeds their limits, check for a fuel leak.

If only one of the background concentrations exceeds its limit, there may be a [gas] analyzer malfunction. Check [gas] analyzer operation.

If two or more of the [gas] background concentrations exceed their limits, check the vehicle exhaust system and CVS dump hose for possible leaks. Indicate on the TAP printout that the vehicle and equipment have been checked for leaks.

If no exhaust leaks are identified, verify the [gas] span is set within 5.0 % of full scale and the zero is set within 2.0 % of full scale. If they are within tolerance, press the read button and analyze the [gas] sample.

If any abnormal occurrences or other conditions cause the [gas] reading to exceed the tolerance limit, record them on TAP.

If unable to determine a reason for the flag, contact a senior technician for a recommendation on appropriate action after he/she reviews the TAP [gas] reading. The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made.

The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout.

Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 6 QC BACKGROUND [bag#] [gas]=[number] <LOWER LIMIT

This flag indicates that the specified [gas] background bag level is below the tolerance limit. Unusual background concentrations can also be caused by analyzer curve shifts, contaminated zero air, or equipment problems.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4 and the [bag#] could be 1B, 2B, or 3B.

Background concentration lower limits:

HC	0.8 PPM (propane)
NO_x	0.0 PPM
CO_2	0.030%
LCO	0.0 PPM
HCO	0.0 PPM
CH_4	1.6 PPM

Operator Response:

Verify the [gas] span is set within 5.0 % of full scale and the zero is set within 2.0 % of full scale. If they are within tolerance, press the read button and analyze the [gas] sample.

If the span and zero are within the tolerance, reread the [gas] sample. If the [gas] flag repeats, there may be a [gas] analyzer malfunction; notify C&M.

If any abnormal occurrences or other conditions cause the [gas] reading to be below the tolerance limit, record them on TAP.

If unable to determine a reason for the flag, contact a senior technician for his/her recommendation on appropriate action after he/she reviews the TAP [gas] reading.

The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made.

The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is recorded on the TAP printout.

Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 7 QC BAG 1 FILL TIME > 510 SEC. (FTP)

This flag indicates that the FTP Bag 1 fill time has exceeded the upper tolerance limit of 510 seconds.

Note: For this flag the [gas] could be HC, NO_x, CO_2, CO, or CH_4.

Operator Response:

Check the TAP report and the VDA Summary Report to determine what events may have caused the bag fill time to exceed the tolerance limit. Some examples and corrective actions are listed below.

Example 1: TAP indicates a bag fill time of 516 seconds.

The VDA Startup Time is 11 seconds and the Drive Time is 505 seconds.

The driver cranked the engine for 9.0 seconds, and 2.0 additional seconds are allowed for reaction time to select the required VDA keyboard commands.

On Form 707-02, record that the engine crank time was 9.0 seconds.

Example 2: TAP indicates a bag fill time of 516 seconds.

The VDA Startup Time is 7 seconds, the Drive Time is 505 seconds, and there is a 4.0 second "HOLD" indicated at 150 seconds into the test.

The driver cranked the engine for 7.0 seconds, and we allowed 2.0 seconds for reaction time to push the VDA buttons. There is also 4.0 seconds that the driver needed to correct a condition, such as an engine stall, which caused them to select "HOLD" on the VDA.

On Form 707-02, record that the engine crank time was 7.0 seconds and document all conditions that may have caused the test to be placed in a "HOLD" condition. The VDA report should have the reason for a "HOLD" documented at the 150-second point of the test.

If any abnormal occurrences, such as those described in the examples or other similar conditions, cause the bag fill time to exceed the tolerance limit, record them on Form 707-02. If unable to determine a reason for the flag, contact a senior technician to recommend appropriate action after they review the TAP and VDA Summary Reports.

The certification representative or project officer should then be contacted, and a determination of valid, variant, or void will be made. The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear and concise description of the conditions and corrective action is documented on the TAP printout. Ensure that long engine crank times, and any abnormal occurrences are recorded on Form 707-02. Confirm that Form 902-01 has been properly completed, if necessary.

Bag Flags

Bags 8 QC BAG 1 FILL TIME < 504 SEC. (FTP)

This flag indicates that the FTP Bag 1 fill time is below the lower tolerance limit of 504 seconds.

Operator Response:

Check the TAP and VDA Summary Reports to determine what events caused the bag fill time to be lower than the tolerance limit.

If any abnormal occurrences or other conditions cause the bag fill time to be below the tolerance limit, record them on Form 707-02.

If unable to determine a reason for the flag, contact a senior technician to recommend appropriate action after they review the TAP and VDA Summary Reports.

If appropriate action can not be determined, contact Quality Technician and/or manager for assistance.

The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made.

The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear and concise description of the conditions and corrective action is documented on the TAP printout.

Ensure that any abnormal occurrences are recorded on Form 707-02.

Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 9 QC BAG 2 FILL TIME > 872 SEC. (FTP)

This flag indicates that the fill time for Bag 2 of the FTP has exceeded the upper tolerance limit of 872 seconds.

Operator Response:

Check the TAP report and the VDA Summary Report to determine what events may have caused the bag fill time to exceed the tolerance limit. Some examples and corrective actions are listed below.

Example: TAP indicates a bag fill time of 876 seconds.

The VDA Drive Time is 864 seconds and there is a "HOLD" condition at 1100 seconds into the test.

In this example there is a 864-second drive time, a 2-second engine shutdown time, a standard 5 second delay time, and a 5-second engine stall time at 1100 seconds.

On the VDA Summary Report, record that the engine stalled at 1100 seconds.

If any abnormal occurrences, such as those described in the examples or other similar conditions, cause the bag fill time to exceed the tolerance limit, record them on Form 707-02.

If unable to determine a reason for the flag, contact a senior technician to recommend appropriate action after they review the TAP and VDA Summary Reports.

The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made.

The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear and concise description of the conditions and corrective action is documented on the TAP printout.

Ensure that any abnormal occurrences are recorded on Form 707-02.

Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 10 QC BAG 2 FILL TIME < 865 SEC. (FTP)

This flag indicates that the FTP Bag 2 fill time is below the lower tolerance limit of 865 seconds.

Operator Response:

Check the TAP report and the VDA Summary Report to determine what events caused the bag fill time to be lower than the tolerance limit.

If any abnormal occurrences or other conditions cause the bag fill time to be lower than the tolerance limit, record them on Form 707-02.

If unable to determine a reason for the flag, contact a senior technician to recommend appropriate action after they review the TAP and VDA Summary Reports.

The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made.

The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear and concise description of the conditions and corrective action is documented on the TAP printout.

Ensure that any abnormal occurrences are recorded on Form 707-02.

Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 11 QC BAG 3 FILL TIME > 510 SEC. (FTP)

This flag indicates that the FTP Bag 3 fill time for has exceeded the upper tolerance limit of 510 seconds.

Note: The CFR allows for an engine crank time up to 10 seconds.

Operator Response:

Check the TAP report and the VDA Summary Report to determine what events may have caused the bag fill time to exceed the tolerance limit. Some examples and corrective actions are listed below.

EXAMPLE 1: TAP indicates a bag fill time of 516 seconds.

The VDA Startup Time is 11 seconds and the Drive Time is 505 seconds.

The driver cranked the engine for 9.0 seconds, and 2.0 seconds are allowed for reaction time to push the VDA buttons. On Form 707-02, record that the engine crank time was 9.0 seconds.

EXAMPLE 2: TAP indicates a bag fill time of 516 seconds

The VDA Startup Time is recorded as 7.0 seconds, the drive time is 505 seconds, and a 4.0 second "HOLD" is indicted at 150 seconds into the test.

The driver cranked the engine for 7.0 seconds and we allow 2.0 seconds for reaction time to push the VDA buttons. There are also 4.0 seconds that the driver needed to correct a condition, such as an engine stall, which caused them to select "HOLD" on the VDA.

On Form 707-02, record that the engine crank time was 7.0 seconds and document all conditions that may have caused the test to be placed in a "HOLD" condition. The VDA report should have the reason for a "HOLD" documented at the 150-second point of the test.

If any abnormal occurrences, such as those described in the examples or other similar conditions, cause the bag fill time to exceed the tolerance limit, record them on Form 707-02.

If unable to determine a reason for the flag, contact a senior technician to recommend appropriate action after they review the TAP and VDA Summary Reports. The certification representative or project officer should then be contacted, and a determination of valid, variant, or void will be made. The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear and concise description of the conditions and corrective action is documented on the TAP printout. Ensure that long engine crank times, and any abnormal occurrences are recorded on Form 707-02. Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 12 QC BAG 3 FILL TIME < 504 SEC. (FTP)

This flag indicates that the FTP Bag 3 fill time is below the lower tolerance limit of 504 seconds.

Operator Response:

Check the TAP and VDA Summary Reports to determine what events caused the bag fill time to be lower than the tolerance limit. If any abnormal occurrences or other conditions cause the bag fill time to be below the tolerance limit, record them on Form 707-02.

If unable to determine a reason for the flag, contact a senior technician to recommend appropriate action after they review the TAP and VDA Summary Reports. If appropriate action can not be determined, contact the Quality Technician and/or manager for assistance. The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made. The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear and concise description of the conditions and corrective action is documented on the TAP printout. Ensure that any abnormal occurrences are recorded on Form 707-02. Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bags 13 QC BAG 1 FILL TIME > 765 SEC. (HWFE)

This flag indicates that the Highway Fuel Economy test (HWFE) Bag 1 fill time has exceeded the tolerance limit of 765 seconds.

Operator Response:

Check the TAP report and the VDA Summary Report to determine what events caused the bag fill time to exceed the tolerance limit.

If any abnormal occurrences or other conditions cause the bag fill time to be exceed the tolerance limit, record them on Form 707-02. If unable to determine a reason for the flag, contact a senior technician to recommend appropriate action after they review the TAP and VDA Summary Reports. If the engine stalls during the HWFE exhaust measurement section, the test is void and must be rerun.

The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made. The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear and concise description of the conditions and corrective action is documented on the TAP printout.

Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 14 QC BAG 1 FILL TIME < 763 SEC. (HWFE)

This flag indicates that the Highway Fuel Economy test (HWFE) Bag 1 fill time is below the tolerance limit of 763 seconds.

Operator Response:

Check the TAP report and the VDA Summary Report to determine what events caused the bag fill time to be below the tolerance limit.

If any abnormal occurrences or other conditions cause the bag fill time to be below the tolerance limit, record them on Form 707-02.

If unable to determine a reason for the flag, contact a senior technician to recommend appropriate action after they review the TAP and VDA Summary Reports.

The certification representative or project officer should then be contacted and a determination of valid, variant, or void will be made.

The operator will then complete and file Form 902-01, if necessary.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout.

Confirm that Form 902-01 has been properly completed and filed, if necessary.

Bag Flags

Bags 15 P [time exceeding 20 min] SINCE BAG FILL

This flag indicates that the analysis time for a specified exhaust sample bag has exceeded the CFR 20-minute limit. The flag will appear at the bottom of the exhaust analysis printout for any bag that exceeds this limit.

Operator Response:

Determine if a stable strip chart reading can be obtained that does not exceed the 20-minute limit. The background and sample readings may be taken from the strip chart and manually entered on Form 708-01, Vehicle Test Data Sheet, provided the zero and span were set within ±0.4 % of full scale.

If the zero and span are not within ±0.4 % of full scale but are within 2% and 5%, respectively, the sample and background readings are usable but must be corrected. Follow the Zero/Span Offset Correction Formula and enter the corrected readings on Form 708-01.

If the zero exceeded 2% of full scale from zero and/or the span exceeded 5% of full scale from the posted span point, notify a senior technician

Make a note on the TAP printout that the strip chart value was used.

If unable to determine an area on the strip chart with a stable trace before the 20-minute time limit has been exceeded, contact a senior technician for their recommendation on appropriate action.

The certification representative or project officer should then be contacted, and a determination of valid, variant, or void will be made.

The operator will then complete and file Form 902-01.

Data Technician Response:

If the stable readings were taken from the strip chart, confirm that does it did not exceed the 20-minute limit and that the data was corrected, if needed.

Confirm that Form 902-01 has been properly completed and filed.

Bag Flags

Bags 16 P

BAGS ALREADY FILLED AND PREVIOUS VALUES EXIST FOR DEWP BARO RR VMIX ELTIM

This flag indicates that either the bag set has already been filled once during this test or there may be equipment problems.

Operator Response:

Circle the flag message on the TAP printout, and check the TAP printout and the VDA Summary Report to determine what events caused the flag.

If unable to determine a reason for the flag, contact a senior technician for their recommendation on appropriate action after they review the message.

C&M and/or Laboratory Automation group may need to be contacted.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Bags 17 N 18 MIN ELAPSED SINCE BAG FILL

This flag indicates that only 2 minutes remain to analyze this exhaust sample bag before the 20-minute CFR time limit is exceeded.

Operator Response:

Expedite the reading of the specified exhaust sample bag to avoid exceeding the CFR 20-minute time limit.

CVS Flags

CVS 1 P MULTI DRIVER EVENTS

This flag indicates that multiple simultaneous signals were received by LCS from the VDA/ CVS interface.

LCS expects to see one of the following CVS/VDA functions selected: Ready, Bag 1, Bag 2, Hot Soak, Bag 3, or EOT.

Operator Response:

Contact LAB Automation group for VDA problems and notify the C&M Manager for other equipment malfunctions.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

CVS 2 A NO DRIVER EVENTS

This flag indicates that the VDA/CVS interface has not selected one of the CVS functions.

LCS expects to see one of the following CVS/VDA functions selected: Ready, Bag 1, Bag 2, Hot Soak, Bag 3, or EOT.

Operator Response:

If using the manual bag selector switch or box, check that the correct button has been selected. One button must always be selected; otherwise, you will get this message.

Contact Lab Automation group for VDA problems and notify the C&M Manager for other equipment malfunctions.

LCS Flags

LCS 1 A BAD OR UNDEFINED TEST NUMBER

This flag indicates that the operator is entering a test number that has not been defined to LCS or contains unacceptable characters.

Operator Response:

Check that the test number is entered correctly. If the number is correct, define the test as "dummy" and all test data must be hand entered on Form 708-01, Vehicle Test Data Sheet.

Transfer all data from the "Dummy" LCS Test Summary printout to Form 708-01.

LCS 2 A BAG DATA MUST BE SAVED FIRST

This flag indicates that a test number is being entered for a dyno on which a previous test is still active. This flag only occurs when a test has not been saved prior to attempting to enter another test number.

Operator Response:

Check and save the currently active test, then enter the new test number.

LCS 3 N DEFAULT TP: 02 USED FOR DUMMY

This flag confirms that "dummy" has been entered for the test number and that the TAP is assuming an 02 (FTP) for the test procedure specification. FTP limits and tolerances will be used during this test.

Operator Response:

No operator response is necessary; the test data will need to be manually entered on Form 708-01, Vehicle Test Data Sheet.

Data Technician Response:

On Form 708-01, verify that the data has been entered correctly.

LCS Flags

LCS 4 N [date - indicating switch at midnight]

This flag indicates that TAP was running at midnight. At this point the TAP resets with a new date and time.

Operator Response: None.

LCS 5 W NO TEST #; CANNOT QUEUE DATA

This flag indicates that the test number was not entered on LCS, or that the test number was entered on the incorrect dyno site.

Operator Response:

Confirm that the correct test number/dyno combination was entered. If the correct combination was used and the flag persists, enter the test as "DUMMY." After the test is complete, all data will need to be manually entered on Form 708-01, Vehicle Test Data Sheet.

Data Technician Response:

Verify that the operator performed the appropriate corrective action. If data is manually entered on Form 708-01, verify that it has been entered correctly.

LCS 6 W RTP READ OUT OF SYNC

This flag indicates that the LCS Real Time Processor (RTP) read is out of synchronization. This is generally due to an LCS system malfunction and can only be addressed by computer operations personnel and/or the Laboratory Automation group.

Operator Response:

If the flag is observed more than once on any one test, contact computer operations and request an LCS log entry to document the occurrence.

Contact the Laboratory Automation group. Note the time of contact with computer operations/ Laboratory Automation group on the printout.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

LCS Flags

LCS 7 A TEST RESULTS ALREADY ON FILE

This flag indicates that test data already exist in LCS for the currently active test. The operator has attempted to save test results for the same test number twice. The data from the first saved test is stored in the computer.

Operator Response:

Verify that the test data has been previously saved. If it has, continue; otherwise, contact the senior technician for assistance.

Verify that you are saving the correct test number on the correct dyno.

LCS 8 N USE COMMA AS THE DELIMITER

This flag indicates that a comma has been omitted from the typed-in command.

Operator Response:

Insert the required comma as requested.

LCS 9 N WAITING FOR TEST INFORMATION

This flag indicates that TAP is functioning normally and is retrieving test information when program responses are delayed.

Operator Response:

Wait for the TAP program response at the terminal before entering the next command.

Roll Rev Flags

Roll Revs 1 QC BAG 1 RR < 8247 (FTP)

This flag indicates that the Bag 1 LCS roll revolution counts are lower than the tolerance limit.

The flag may be due to dynamometer or VDA interface problems.

Operator Response:

If unable to determine the cause and the DVU readings are within 8247 to 8499 revolutions, circle the flag message and record the DVU roll rev reading on the TAP printout.

Notify C&M personnel.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Roll Revs 2 QC BAG 1 RR > 8499 (FTP)

This flag indicates that the Bag 1 LCS roll revolution counts are higher than the tolerance limit.

The flag may be due to dynamometer or VDA interface problems.

Operator Response:

If unable to determine the cause and the DVU readings are within 8247 to 8499 revolutions, circle the flag message and record the DVU roll rev reading on the TAP printout.

Notify C&M personnel.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Roll Rev Flags

Roll Revs 3 QC BAG 2 RR < 8863 (FTP)

This flag indicates that the Bag 2 LCS roll revolution counts are lower than the tolerance limit.

The flag may be due to dynamometer or VDA interface problems.

Operator Response:

If unable to determine the cause and the DVU readings are within 8863 to 9223 revolutions, circle the flag message and record the DVU roll rev reading on the TAP printout.

Notify C&M personnel.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Roll Revs 4 QC BAG 2 RR > 9223 (FTP)

This flag indicates that the Bag 2 LCS roll revolution counts are higher than the tolerance limit.

The flag may be due to dynamometer or VDA interface problems.

Operator Response:

If unable to determine the cause and the DVU readings are within 8863 to 9223 revolutions, circle the flag message and record the DVU roll rev reading on the TAP printout.

Notify C&M personnel.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Roll Rev Flags

Roll Revs 5 QC BAG 3 RR < 8247 (FTP)

This flag indicates that the Bag 3 LCS roll revolution counts are lower than the tolerance limit.

The flag may be due to dynamometer or VDA interface problems.

Operator Response:

If unable to determine the cause and the DVU readings are within 8247 to 8499 revolutions, circle the flag message and record the DVU roll rev reading on the TAP printout.

Notify C&M personnel.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Roll Revs 6 QC BAG 3 RR > 8499 (FTP)

This flag indicates that the Bag 3 LCS roll revolution counts are higher than the tolerance limit.

The flag may be due to dynamometer or VDA interface problems.

Operator Response:

If unable to determine the cause and the DVU readings are within 8247 to 8499 revolutions, circle the flag message and record the DVU roll rev reading on the TAP printout.

Notify C&M personnel.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Roll Rev Flags

Roll Revs 7 QC BAG 1 RR < 23644 (HWFE)

This flag indicates that the Highway Fuel Economy (HWFE) Bag 1 LCS roll revolution counts are lower than the tolerance limit.

The flag may be due to dynamometer or VDA interface problems.

Operator Response:

If unable to determine the cause and the DVU readings are within 23644 to 24170 revolutions, circle the flag message and record the DVU roll rev reading on the TAP printout.

Notify C&M personnel.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

Roll Revs 8 QC BAG 1 RR > 24170 (HWFE)

This flag indicates that the Highway Fuel Economy (HWFE) Bag 1 LCS roll revolution counts are higher than the tolerance limit.

The flag may be due to dynamometer or VDA interface problems.

Operator Response:

If unable to determine the cause and the DVU readings are within 23644 to 24170 revolutions, circle the flag message and record the DVU roll rev reading on the TAP printout.

Notify C&M personnel.

Data Technician Response:

Ensure that a clear, concise description of conditions and action taken is written on the TAP printout**.**

VMIX Flags

VMIX 1 W UNUSUAL VMIX=[#] CHECK VMIX COUNTS

This flag indicates that LCS has detected an unusual CVS count during a specific test time.

Operator Response:

If the TAP VMIX counts disagree with the CVS VMIX digital display by more than ±15 counts, record the CVS VMIX digital display counts on the LCS TAP printout.

Contact C&M and document the time of contact on the TAP printout.

Note: The CVS VMIX digital display reading is at the end of the test phase.

Data Technician Response:

If CVS VMIX digital display counts are different than the TAP VMIX by more than ±15 counts, ensure that the CVS VMIX digital display counts are recorded on Form 708-01.

VMIX 2 QC VMIX2/VMIX1 < 1.64

This flag indicates that the Bag 2 to Bag 1 sample volume ratio is below the normal range, that is below the statistical limit ratio of 1.64.

Operator Response:

Record the Bag 1 and Bag 2 CVS VMIX digital display counts on the TAP printout.

If either Bag 1 or Bag 2 has an unusual Bag Time or VMIX, that is probably the reason for this flag.

If unable to determine a reason for the flag, contact a senior technician for their recommendation on appropriate action after they review the TAP message.

If appropriate action can not be determined, contact the Quality Technician and/or manager for assistance.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

VMIX Flags

VMIX 3 QC VMIX2/VMIX1 > 1.76

This flag indicates that the Bag 2 to Bag 1 sample volume ratio is above the statistical limit of 1.76.

Operator Response:

Record the Bag 1 and Bag 2 CVS VMIX digital display counts on the TAP printout. If either Bag 1 or Bag 2 has an unusual Bag Time or VMIX, that is probably the reason for this flag.

If unable to determine a reason for the flag, contact a senior technician for their recommendation on appropriate action after he/she reviews the TAP message.

If appropriate action can not be determined, contact the Quality Technician and/or manager for assistance.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

VMIX 4 QC VMIX1/VMIX3 < .969

This flag indicates that the Bag 1 to Bag 3 sample volume ratio is below the statistical limit of 0.969.

Operator Response:

Record the Bag 1 and Bag 3 CVS VMIX digital display counts on the TAP printout. If either Bag 1 or Bag 3 has an unusual Bag Time or VMIX, that is probably the reason for this flag.

If unable to determine a reason for the flag, contact a senior technician for their recommendation on appropriate action after they review the TAP message.

If appropriate action can not be determined, contact the Quality Technician and/or manager for assistance.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

VMIX Flags

VMIX 5 QC VMIX1/VMIX3 > 1.041

This flag indicates that the Bag 1 to Bag 3 sample volume ratio is above the statistical limit of 1.014.

Operator Response:

Record the Bag 1 and Bag 3 CVS VMIX digital display counts on the TAP printout. If either Bag 1 or Bag 3 has an unusual Bag Time or VMIX, that is probably the reason for this flag.

If unable to determine a reason for the flag, contact a senior technician for their recommendation on appropriate action after they review the TAP message.

If appropriate action can not be determined, contact the Quality Technician and/or manager for assistance.

Data Technician Response:

Ensure that a clear, concise description of the conditions and action taken is written on the TAP printout**.**

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